

Appendix 5

How to Obtain Mexican Maps

William R. Elliott

For general navigation get a good road map or atlas of Mexico, but do not expect it to show caves, unless they are heavily visited tourist spots. Back roads, villages, river names, and sierra names usually require printed or digital topographic maps. The regional map in the back of this volume was created from INEGI topographic maps at 1:250,000 scale.

INEGI, the official Mexican mapping agency or Instituto Nacional de Estadística y Geografía, has a great website with free access to most GIS coverage (maps). An account is no longer needed to download these files, which are a wonderful resource to scientists and cavers. It is interwoven with the **Mapa Digital de México** (more below). You can print your own maps for field use, or just put them on a laptop or a tablet.

Find the INEGI website, <http://www.inegi.org.mx/> click on *Mapas*, and under *Filtros* select *Escala*, and pick the 1:50,000 scale, usually the most widely available and detailed. Then, for example, search for F14A89 or Damián Carmona (the Micos area) in *Búsqueda básica*, then download any of four resulting formats for Damián Carmona (.pdf, .tif, .gif, and .shp). Two other formats, geo.pdf and .bil are sometimes available. The .bil format is peculiar to Mexican GIS, providing a dem (digital elevation model) in vector format (I have not been able to use it in QGIS or WallsMap).

The best and easiest general coverage for your cave geographic information system (GIS) is a 1:50,000 geotiff (georeferenced .tif), which is a raster (bitmap) image that has embedded coordinates, usually in the Mexican datum ITRF92 (equivalent to NAD83 or WGS84) using decimal degrees.

Georeferenced .tif and .gif files are viewable with any bitmap viewer or a GIS. Do not draw on them with a bitmap editor or they will lose their georeferencing. INEGI .shp files (shapefiles) are sharp, vector files that can only be used in a GIS, have up to 35 layers as separate files, and thus it may take a long time to set them up. Sometimes a few prominent cave locations are presented in a special layer.

See the topo index map of Mexico, Figure A5.1. There are many useful coverages at 1:50,000, 1:250,000, and sometimes 1:20,000 and other scales, for topography, geology, and other subjects, in several formats. Generally they are useable in a GIS with a WGS84 datum, but can be re-projected to UTM Zone 14 or other projection in WGS84 or NAD83. The maps can be re-projected in QGIS, ArcGIS, or Global Mapper.

A “geo.pdf” is very large, sharp, georeferenced file that is useable in a GIS, which provides you with coordinates and tools for marking locations. The regular .pdf files from INEGI are also sharp. Both can be viewed in Adobe Acrobat Reader, but coordinates are not provided automatically. The **TerraGo Technologies** plug-in to Adobe Reader may offer live coordinate displays with true geo.pdfs that conform to TerraGo’s standards. I tried the plugin on a “geo.pdf” from INEGI of the Tamasopo area, 1:50,000, F14C18, but the TerraGo tool reported that it was not a true geopdf and it would not provide geographic tools for it.

A .pdf or geo.pdf can be printed in segments for field use, or it can be used in Adobe Acrobat Reader like a basic GIS with built-in layers that you can turn on/off. You can post a sticky note on a location, but there is no display of the coordinates. The sheet does show a UTM grid of 1-km squares, and the coordinates are given on the edge of the sheet. Latitude and longitude is only given at wide intervals in degrees/minutes on the edge, not very helpful for plotting locations in that system.

The online **Mapa Digital de México** does not show topography, but it shows many roads and place names not seen in Google Earth (GE), and exact decimal degree coordinates can be obtained for any point. One can search for maps and coverages, then download them. For example, I clicked *Mapa Digital de México en línea* and searched for San Luis Potosí, and got an outline map of that state. Then I searched for Tamasopo and found a number of map products. Then I downloaded the F14C18 Tamasopo geo.pdf, 23 MB.

It is better to take GPS coordinates in the field in decimal degrees for later use in a GIS. But they can be converted in WallsMap. Also, you can set your GPS receiver to UTM, NAD83 or WGS84, or degrees/minutes/seconds in order to match the grid on the pdf for manually plotting locations, then switch back to decimal degrees, converting the coordinates correctly if you use WGS 84 or NAD83 datum. Some old INEGI maps are NAD27, and that will differ by about 200 m from the WGS 84 or NAD83 datum.

One might be able to obtain an iPhone or iPad with GPS receiver and offline Mexican topo maps, which would be very useful. TerraGo makes a free iPhone app for reading true geopdfs, which may not be available from INEGI anyway.

Peter Sprouse (pers. comm.) uses an old Windows 8

tablet (HP Slate) with WallsMap, which can read the input from an external GPS receiver. Such a tablet can be paired with a Qstarz or Bad Elf external GPS receiver via bluetooth, and one can use it in the field to mark new caves or go to known caves. The topo maps in WallsMap can be a .shp file, a compressed .nti, or a geotiff (georeferenced .tif), which can be converted to .nti in the program. It cannot use a .pdf. WallsMap and QGIS are free. QGIS can also be used in the field with a linked GPS receiver, and it can use many formats, including .kml or .kmz point files from Google Earth.

Google Earth is a good webGIS that provides satellite views, coordinates, elevations, and the ability to mark locations and save them as .kml or .kmz files, which can be imported to QGIS on your home computer. Large sótanos may be seen from the satellite views on GE, however, anything obscured by foliage will not be seen. The public photos embedded in GE are often useful. The drawback to GE is that you cannot see the topography as contour lines, and even large dolinas are not visible because of all the foliage. However, large, black pit entrances are visible, but

tanques (water tanks or ponds) also look like dark holes, so be skeptical.

A useful commercial website, **East View Geospatial**, has an interactive index map of Mexico for 1:50,000 and 1:250,000 scales. A grid map is on the site, and you zoom into it and pan around. As you zoom you will see more town names, so if you can find a place you know you can find the topo's INEGI index number. Below that they have a list of index numbers with topo names, although many of them have typographical errors because of poor conversion of INEGI's accented characters. If you zoom to one topo sheet and click on it you will get a synopsis with the index number, sheet name, and scale. One can pay East View \$19 for a printed map, or a few dollars for a geotiff or shapefile. Or one can go to INEGI's website, find that index number, and download it for free. East View does not carry the 1:20,000 sheets from INEGI, which are high-resolution views of terrain with 10-m contours, vs. the usual 20 or 50-m contours.

Figure A5.1. An example index map of 1:50,000 topos from collar of the Aquismón F14C29 sheet, showing neighboring sheet numbers. A zoomable, interactive index map is at the Geospatial (East View) website.

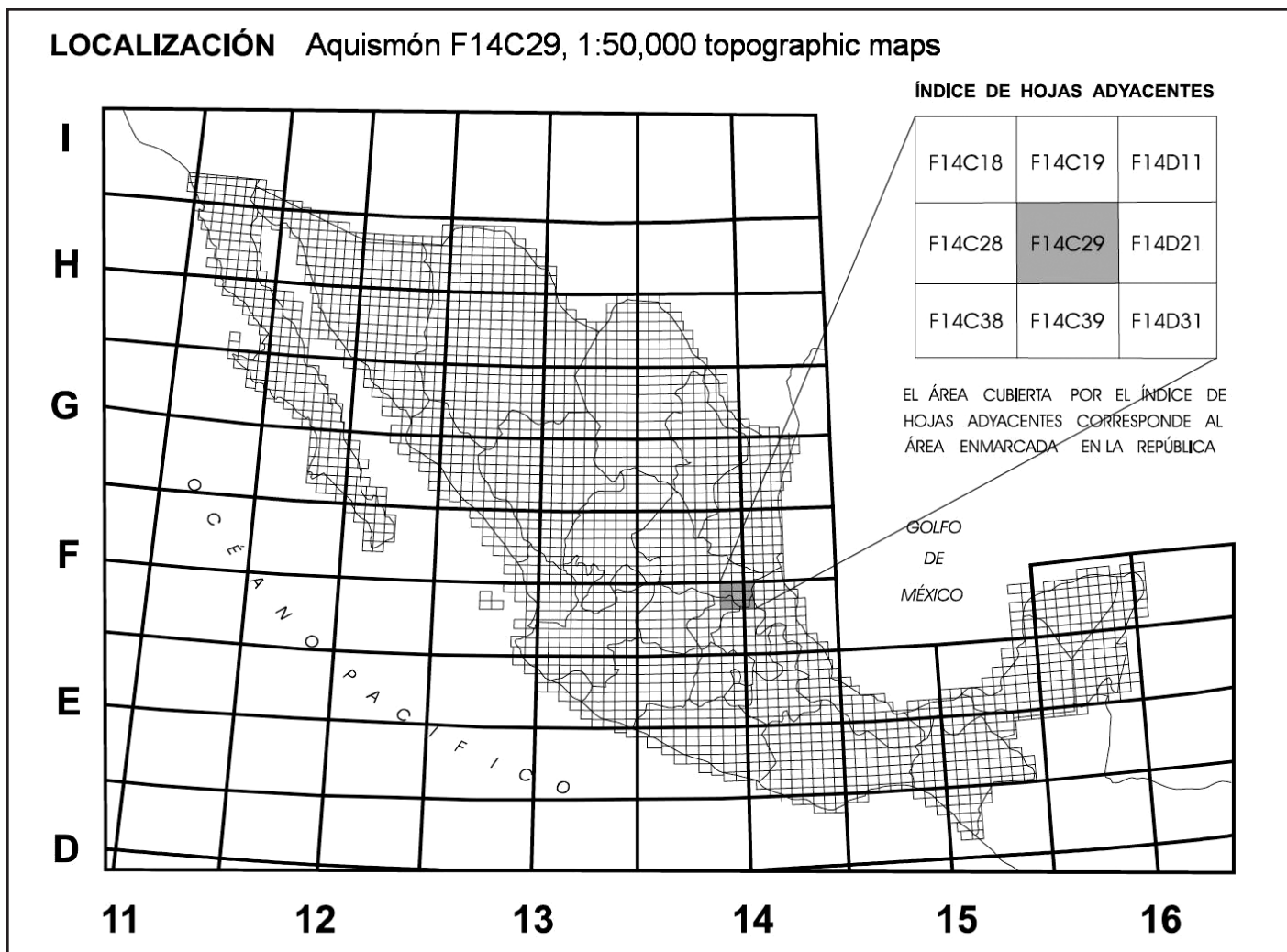


Table A5.1. INEGI 1:50,000 topographic maps covering the Sierra de El Abra Region. Cells in blue are maps with known *Astyanax* caves, with example caves given in each cell.

F14A38 Jaumave	F14A39 Llera de Canales	F14B31 Las Compuertas	Geographic Names
F14A48 El Llano de Azuas	F14A49 Gómez Farías [Molino, Jineo, Escondido]	F14B41 Ignacio Zaragoza	<i>Sierra de Guatemala (Mateguala)</i>
F14A58 Ocampo [Gallitos]	F14A59 Loma Alta [Bee, Caballo Moro, Vásquez]	F14B51 Xicoténcatl	<i>Sierra de Cucharas (El Abra)</i>
F14A68 Salto del Agua	F14B69 Quintero [El Pachón, Nac. Río Mante]	F14B61 Ciudad Mante	<i>Sierra de Cucharas (El Abra)</i>
F14A78 Ciudad del Maíz	F14A79 Sierra la Colmena [Venadito]	F14B71 Div. del Norte [pits on crest]	Tamaulipas San Luis Potosí
F14A88 Alaquines	F14A89 Damián Carmona [Micos caves]	F14B81 Las Palmas [Cd. Valles, Yerbaniz, Los Sabinos]	<i>Sierra Tanchipa (El Abra)</i>
F14C18 Tamasopo [Cueva del Fraile]	F14C19 Rascón [Gruta La Escondida]	F14D11 El Pujal [Cueva Chica]	<i>Sierra Abra</i>
F14C28 Lagunillas	F14C29 Aquismón	F14D21 Coxcatlán	

Useful Websites

<http://www.inegi.org.mx/>

<http://www.terragotech.com/products/terrago-toolbar>

<http://www.inegi.org.mx/geo/contenidos/mapadigital/>

If a reader has difficulty obtaining or using INEGI coverages, please contact the author at speodesmus@gmail.com.

<http://geospatial.com/products/series/topographic-maps/mexico-scale-1-50000-topographic-maps-779/>

